

## **“Discovery of Sound in the Sea” Website**

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<http://www.dosits.org>

### **LONG-TERM GOALS**

The long-term goal of this effort is to educate the public on the basic science of sound in the sea; how people and animals use underwater sound to accomplish many of the tasks for which we use light in air; and how sound in the ocean affects marine life. The products of this effort include an interactive on-line resource, a CD-ROM, and printed materials.

### **OBJECTIVES**

The objective of this effort is to develop and maintain resources that address the long-term goal. The resources include a website (Figure 1), an educational CD-ROM, a tri-fold educational pamphlet, and an informational 16-page booklet.

### **APPROACH**

Efforts have focused on enhancing and expanding the scientific content of the *Discovery of Sound in the Sea* website that was launched in November 2002. During the past nine years, Marine Acoustics, Inc. (MAI) and the University of Rhode Island’s Office of Marine Programs (OMP) have developed a successful working relationship to create the website, an educational CD-ROM, and associated printed materials. These resources undergo regular updates and rigorous scientific review by a panel of scientists in the field, led by Drs. Peter Worcester (Scripps Institution of Oceanography), Jim Miller and Jacqueline Webb (University of Rhode Island), and Darlene Ketten (Harvard University Medical School and Woods Hole Oceanographic Institution). MAI and OMP make all final decisions on the site content.

## Report Documentation Page

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**Figure 1: Interactive front page of “Discovery of Sound in the Sea” website (<http://www.dosits.org>)**

## WORK COMPLETED

During the ninth year of research, MAI and OMP focused on several tasks to enhance and expand the website that was launched in November 2002, and to reach additional audiences that have not been targeted in the past. These tasks included the following:

- Redesign of the DOSITS website.
  - Raytheon Web Solutions (RWS) modified the content-management system to allow inline citations on webpages. This feature educates users quickly and efficiently on the peer-reviewed, published literature on which the DOSITS content is based. Once the citation feature was created, MAI and OMP inserted citations to refer the user to the original data and research supporting the DOSITS content.
  - RWS created an enhanced references and resources feature that could be associated with each DOSITS webpage. By including references and resources on each content pieces, DOSITS can direct users to additional information available regarding the content on each webpage.
  - RWS provided the web architecture for OMP and MAI staff to implement an enhanced download capability. As the website has evolved, individual researchers have been

contacted to provide images and sound files for use on the DOSITS website, educational CD, and printed materials. Permission to use these files has been obtained primarily via informal email correspondence. With the redesign of the website and the sophisticated downloading capabilities of software programs, it is necessary to clarify the permissions that have been granted by these researchers. RWS provided the architecture for varying permission levels to be associated with each image, sound, and video file included on the DOSITS website. Each researcher will be contacted and asked to complete a copyright authorization form. Future work will then include a copyright information button for each image and sound file that will provide the authorized download details associated with each file. This enhanced copyright information and link will be tied into the content-management system of the website architecture, providing enhanced functionality and easy expansion in the future.

- Static format for CD/DVD. The new and improved DOSITS website redesign includes Flash interactive components that draw material from the content-management system architecture. It is complicated to transfer such a system to a static format such as a CD or DVD; however, teachers continually emphasize the importance of a static resource for use in their classrooms or when Internet access is not available. RWS developed a static, stand-alone version of the website that works seamlessly on a CD/DVD.
- Revision of content on the page “How is sound viewed and analyzed?” to reflect prevalence of display characteristics on DOSITS. This page within the Science of Sound section has grown by leaps and bounds as the complexity of the DOSITS website has grown. When a method for viewing or analyzing sounds was included on another page of the website, a simple description and image were added to this page as a reference for the general public. This page became long and complex itself, thereby losing its objective as a basic introductory page. The DOSITS team restructured the content to satisfy the needs of both the general public and sophisticated acousticians in understanding how sounds are viewed and analyzed.
- Enhancements to the Audio Gallery. Two new search structures were implemented to display entries based on category (e.g., marine mammals, anthropogenic sounds, etc.) or taxonomy. The Audio Gallery has traditionally been accessed via a lengthy list of all sound sources on one splash page. While this was effective with previous web software, it has become outdated and cumbersome as new sound sources are added. The new structure capitalizes on the interactive options available with the current redesign. With the innovative website redesign that RWS has produced, users now may select sound sources from a drop-down menu that includes category and taxonomy. Marine animals are typically referenced by their scientific names, therefore, it is beneficial to include a drop-down menu by family.
- Updates to the Animals and Sound in the Sea section.
  - Reviewed recently published, peer-reviewed literature to update existing scientific content, particularly the effects of underwater sound on marine life.
  - Revised and updated Animals > Effects > Marine Mammals > Strandings section with newly published literature, including adding information on the ongoing Behavioral Response Studies, referencing the recently published Tyack et al. 2011 manuscript.
  - Revised and updated Animals > Effects > Marine Mammals > Hearing Loss
  - Revised and updated Animals > Effects > Measure Reactions > Hearing Sensitivity Studies

- Revised and updated Advanced Topics > TTS Studies
  - Revised and updated Animals > Effects > Marine Mammals > Masking
  - Revised and updated Animals > Effects > Fishes > Behavioral Effects
  - Added new page Animals > Effects > Fishes > Masking
- Expansion of the Audio Gallery. New sounds added to the DOSITS Audio Gallery include harbor porpoise vocalizations, sei whale vocalizations, and Sausalito midshipman sounds. In addition, the needs assessment showed that longer audio files would be very helpful for educators who use the DOSITS site in their classrooms. Currently, the audio files are in the range of 10-15 seconds. Longer audio files were added when possible.
- Expansion of the Technology Gallery. One section of research that is gaining momentum is the use of acoustics to observe and monitor marine animals. A new section was added to the Technology Gallery that highlights the technologies that are used for Observing and Monitoring Marine Animals. This new section includes equipment such as acoustic fish tags, archival marine acoustic recording units (ARUs), real-time passive acoustic sensors, and acoustic gliders. These kinds of new technological developments are important to incorporate into the DOSITS site so that it contains the most up-to-date content.
- Increase readily available resources for educators. The DOSITS site is used in many classrooms around the country and teachers are continually expressing their appreciation of the resources available to them through our Teacher Resources section. We added two new PowerPoint presentations that contain DOSITS content at levels specifically targeting elementary and middle school grade levels. We also created a new activity called “Stirring Up Sound” that was presented at the National Science Teacher Association meeting and at the Girl Scout Session at the Acoustical Society of America meeting in Seattle and is posted in the Teacher Resources. We are working to enhance the Teacher Resources section with a new outreach tool called “Featured Teachers.” Teachers that are using the DOSITS resources have been contacted and will be highlighted with a brief description of their classroom, curriculum, and how DOSITS is used. As successive teachers are highlighted or featured, the previous examples would become a new component of the Teacher Resources section, enhancing the site long-term. In particular, several teachers that have participated in the ARMADA Project, a NSF-funded program that places K-12 teachers in active ocean science research and mentoring experiences, have developed teacher activities that utilize DOSITS materials. These teachers represent a wealth of ocean science education and activities. By highlighting them as Featured Teachers, the number of teacher activities available would also increase.
- New sections in Science > Sound Measurement on “What can animals hear.” As new content was developed on how marine animals hear sounds, it became obvious that a new section on the sounds that animals can hear was necessary. In the Science > Sound Measurement section, the page “How is hearing measured” was updated with additional images, new content, and new glossary terms. Two new pages were created in the Science > Sound Measurement section: “What can we hear” and “What can animals hear” to explain hearing curves and include sample audiograms that demonstrate the range of sensitivities for various species.
- Expansion of the page People > Investigate Marine Animals > How is sound used to study marine mammal distribution to include a case study of research in Stellwagen Bank National

Marine Sanctuary. Innovative research is occurring in Stellwagen Bank National Marine Sanctuary as researchers from Cornell University, the Sanctuary, and the National Marine Fisheries Service Northeast Fisheries Science Center collaborate to understand North Atlantic right whales. As one of the most endangered populations of whales, North Atlantic right whales spend a significant portion of their lives on Stellwagen Bank. Researchers have placed a network of underwater recorders within the Sanctuary to study the movement of animals over several years. New content was added that highlights this cutting-edge research and documents the utility of passive acoustics in understanding a species on the brink of extinction.

- New page on People > Investigate Marine Animals > How is sound used to estimate marine mammal abundance. As passive acoustic recorders have increased in use, large repositories of data have accumulated. In the past, these databases would be manually reviewed by scientists, a very labor intensive and time consuming enterprise. New research is studying automated algorithms for detecting, classifying, and localizing sounds in an attempt to reduce the time and expense of evaluating these data. One objective of this research is to develop methods for estimating animal abundances from passive acoustic data. A new page was added that includes information on how animal densities are currently estimated from visual surveys and how passive acoustics is being used to compliment the traditional methods.
- New page on People > Investigate Marine Animals > How is sound used to protect marine mammals. Human impacts on marine animals include entanglements in open-ocean and coastal fisheries, interactions with aquaculture facilities, and ship strike. Acoustic devices are being employed as tools to reduce risk and decrease these human impacts. This new section discusses how pingers are helping to reduce the risk of entanglement in gillnet gear for harbor porpoises; how passive acoustics are being used to monitor sperm whale interactions in longline fishing gear in the North Pacific Ocean; how acoustic harassment devices (AHDs) are preventing conflicts between pinnipeds and aquaculture facilities; and how real-time automatic-detection buoys are monitoring North Atlantic right whale locations to avoid ship strike.
- New page on People > Examine the Earth > How is sound used to research wind energy. It is becoming increasing clear that alternative energy needs to be included in future planning scenarios. Many states have declared that 15 to 20 percent of their energy consumption must come from renewable sources within the next five to ten years. In order for these developments to occur, however, new construction and operation procedures must be created. In addition, the best possible locations for alternative energies must be selected. Advisory board member Jim Miller is working with the state of Rhode Island to develop an Ocean Special Area Management Plan in order to proactively plan for future alternative energy developments in the marine environment. This new section focuses on how underwater acoustics is being used to research alternative energy strategies.
- New sections on ocean noise. Three new pages on ambient noise levels and how they are influenced by marine life, ocean acidification, and shipping were created to reflect recently published literature and to clarify misinformation in media. Recent research by Keith Hester and colleagues has made claims that ocean acidification due to increased uptake of CO<sub>2</sub> from the emissions of fossil fuel will result in significant decreases in ocean sound absorption for frequencies lower than about 10 kHz. They suggest that decreased sound absorption will increase significantly ambient noise levels in the ocean at frequencies that are critical to environmental, military, and economic interests. Evaluating this new research in a discussion

on the DOSITS website is an example of how the website can introduce critical thinking of current science to the public.

- Added cross-links between existing content. The DOSITS website has grown by leaps and bounds. While an attempt was made to integrate new material with existing content, additional cross-references were needed among content pieces to provide a broader understanding of this complex topic. In addition, with eight years of detailed web traffic data, cross-links from webpages that receive high amounts of web traffic, such as the Audio Gallery, can draw the user into pages that have traditionally received less traffic.
- Produced a CD and updating the PowerPoint files. The CD contains the most current version of the website for use while not connected to the internet, and PowerPoint files of the major sections of the website for teachers to use in their classroom. The PowerPoint files covered the website sections of Science of Sound in the Sea, People and Sound in the Sea, Marine Mammals and Sound in the Sea, Fish and Invertebrates and Sound in the Sea, the Name That Sound activity, and the Jeopardy activity, and are accompanied by Word documents that included teaching notes and suggestions.
- Updated and printed a tri-fold educational pamphlet and informational booklet. During 2005, the DOSITS team produced two valuable public affairs publications. The tri-fold pamphlet introduces the public to the issues and science content of DOSITS. The second publication is an educational booklet that provides an in depth look at Sound in the Sea and targeted issues for interested stakeholders, policymakers, and the public. This year we expanded the booklet to 16 pages to include additional content on animals, people, and the effects of sound on marine life. Newly revised versions of these publications are now available.
- Conducted peer review of the website. A review meeting with the advisory team was held at URI during December 2010 and May 2011 to review the draft revised version of the website. All new and revised content created for the website underwent peer review during this time period. In addition to the advisory team, the DOSITS scientific content has been reviewed by over 40 scientific experts (see <http://www.dosits.org/about/> for a complete list).

## RESULTS

The “Discovery of Sound in the Sea” website has received an incredible response. It was first launched in November 2002. Through May 2011, DOSITS has had more than 43 million hits (Figure 2). In March 2010, a new site design was launched. The new design, along with a promotional push, saw the site traffic grow. From January through May 2011, DOSITS has had just over 4 million hits, 284,000 page view, and served 68 GB of data.

## IMPACT/APPLICATIONS

The “Discovery of Sound in the Sea” website and printed publications are resources for educating and exposing the public to the basic science of sound in the sea and how it is used to communicate, navigate, and explore the oceans. By providing information in multiple formats, teachers can bring this content into their classrooms; public affairs personnel can inform themselves of controversial issues and provide materials to Congress; and the public can begin to include science in their decisions. DOSITS is recognized as a resource by established journal outlets, as evidenced by our involvement in the January 2011 issue of National Geographic “The Big Idea” section

(<http://ngm.nationalgeographic.com/2011/01/big-idea/noisy-ocean>). DOSITS was also recognized as a resource by the Naval educational community at the ONR Science, Technology, Engineering, and Mathematic (STEM) Forum in Arlington, VA this spring, where we displayed the website and demonstrated teacher resources at an invited booth.

## TRANSITIONS

DOSITS is recognized as the world leader in education and outreach on underwater acoustics. With the appropriate permissions, the National Oceanic and Atmospheric Administration has incorporated components of the DOSITS Audio Gallery into its exhibit “Sounds of the Sea” for the Smithsonian Institution’s National Museum of Natural History Ocean Hall “Oceans Today” kiosks. These kiosks are located at the entrance to the Ocean Hall, thereby making it one of the first components that visitors to this newly constructed exhibit will encounter. This prominent placement ensures a very broad impact from the work of the DOSITS team.

## RELATED PROJECTS

None.

## PUBLICATIONS

“Discovery of Sound in the Sea” website

“Discovery of Sound in the Sea” CD-ROM

Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2010. Discovery of Sound in the Sea. University of Rhode Island. (12-page information booklet)

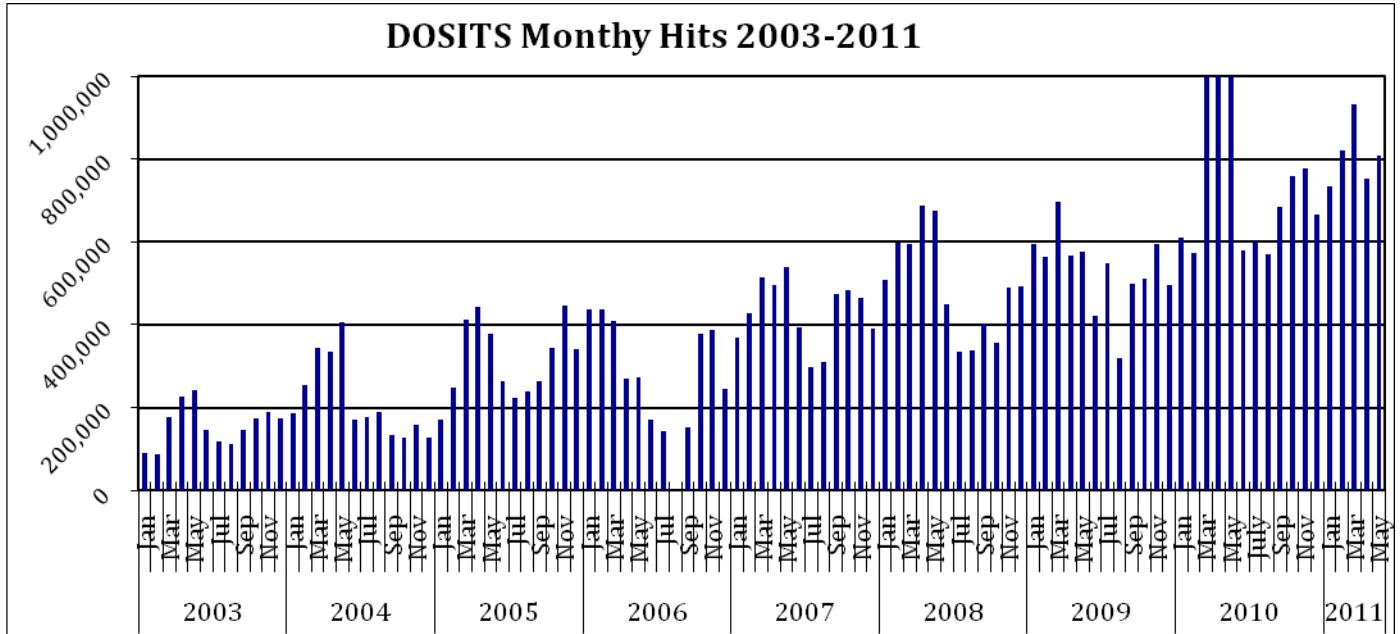
Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2010. Discovery of Sound in the Sea. University of Rhode Island. (tri-fold pamphlet)

Vigness-Raposa, K.J., Scowcroft, G., Miller, J.H., and Ketten, D.R. In press. Discovery of Sound in the Sea: An on-line resource. *In: The Effects of Noise on Aquatic Life* (Arthur N. Popper and Anthony Hawkins, eds.). Springer, New York.

Vigness-Raposa, K.J., Scowcroft, G., Knowlton, C., and Worcester, P.F. 2008. Discovery of Sound in the Sea Website: An educational resource. Bioacoustics 17: 348-350.

## HONORS/AWARDS/PRIZES

2007 Acoustical Society of America Science Writing Award for Media other than an Article



**Figure 2: The “Discovery of Sound in the Sea” website (<http://www.dosits.org>) has received over 43 million hits since it was first launched in November 2002.**